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ABSTRACT

This document describes the Technology Training Program (TTP) designed as an approach to human resource development. Objectives of the program include: (1) increasing the supply of technicians and paraprofessionals in energy and energy-related fields; (2) providing laboratory or industrial-based training experiences; (3) sharing TTP instructional materials with educational institutions and industry; (4) providing opportunities to develop technical skills; and (5) demonstrating the feasibility of using government facilities to meet local and regional labor requirements. Examples of TTP in operation are included. This program was implemented under the direction of the Energy Research and Development Administration (ERDA) with funding from the National Science Foundation (NSF). (MA)

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ERDA–77-78

ED161687

An Innovative Approach to Human Resource Development

Energy Research & Development Administration
Division of Labor Relations
Washington, D.C. 20545

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Foreword

The urgency of energy problems in the United States has been amply demonstrated by events in recent years, particularly the oil embargo in 1973, and the severe winter in 1977. The problems are both urgent and very complex. Developing and implementing solutions require the combined and coordinated effort of many segments in our society, including government at all levels, industry, research and development institutions, and the American public.

Part of the complexity of solving energy problems is that many technological, environmental, economic, and social factors must be dealt with simultaneously. These factors are intertwined, forming a dynamic system in which changes to one part can have significant consequences on other parts of the system. Needed are innovative approaches that recognize these interdependencies and the powerful effects that can be achieved by combining and coordinating resources from different segments of society.

This brochure describes one such innovative approach in the area of human resource development. It is called the Technology Training Program (TTP). The program was carried out under the direction of the Energy Research and Development Administration (ERDA) with funding support from the National Science Foundation, and with the cooperation of several other Government and private organizations. Although TTP is limited in scale, and represents only a small step forward in solving the human resource implications of energy problems, it is a good example of what can be accomplished when cooperative efforts are applied to achieve interdependent goals.

This brochure relates the story of TTP and explains the concept underlying the program. It is hoped that the information presented will aid others in their search for creative approaches to developing manpower training programs, particularly in critical energy areas. Inquiries concerning TTP should be directed to the Manpower Development Branch, Division of Labor Relations, Washington, D.C. 20545.

James R. O'Gwin

Assistant Director
for Contractor Manpower

Division of Labor Relations

Technology Training Program

An Innovative Approach to Human Resource Development

July 1977

Energy Research & Development Administration
Division of Labor Relations
Washington, D.C. 20545

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Technology and Human Resource Development

The Technology Training Program (TTP) was established by ERDA to deal with two issues related to evolving energy technologies: (1) human resource development, and (2) technology transfer. TTP does this by addressing some of the implications of rapid energy technological development on the skill training requirements for technicians and paraprofessionals in energy or energy-related fields, and by strengthening mechanisms for transferring new energy technologies from research and development centers to other organizations. These issues have been conceptualized as two interdependent organizational goals stemming from technological development. TTP is based on these goals and on the unique training opportunities that exist within the ERDA system of contractors. Figure 1 places TTP in a systems framework and shows the interrelationships between TTP and other parts of the system.

A long-range program of research and development to advance energy technology is a major component of the national effort to avert serious energy shortages. The objective of the program is to develop new or improved sources of energy and more efficient ways to use all energy, and to do so before our nonrenewable energy resources are depleted. At the Federal level, this program is administered and coordinated by the Energy Research and Development Administration (ERDA).

Americans have an abiding faith in technology as the ultimate solution to many kinds of problems. In the past, the energy problem has been predominantly viewed as a technological problem, one that called for a technological solution. Increasingly, however, it is recognized that technological development is interrelated in complex ways with many social and economic factors and that a plan to effectively use technology in solving problems must include these interrelationships.

Human Resource Development

Successful energy technological development depends to a great extent on the quantity and quality of human resources that are applied to energy problems. The Congress assigned ERDA the responsibility of "helping to assure an adequate supply of manpower for the accomplishment of energy research and development programs, by sponsoring and assisting in education and training activities in institutions of higher education, vocational schools, and other institutions."

When, and in what manner, ERDA increases its involvement in training activities depends on several underlying premises. These are important for understanding the role ERDA has played in the Technology Training Program and the impetus for establishing the program.

☐ QUANTITY AND QUALITY

Both the quantity and quality of energy manpower are important issues, but quality is especially important in a research and development environment. Relatively few numbers of people may be required, but they must be highly trained and often must possess unique skills.

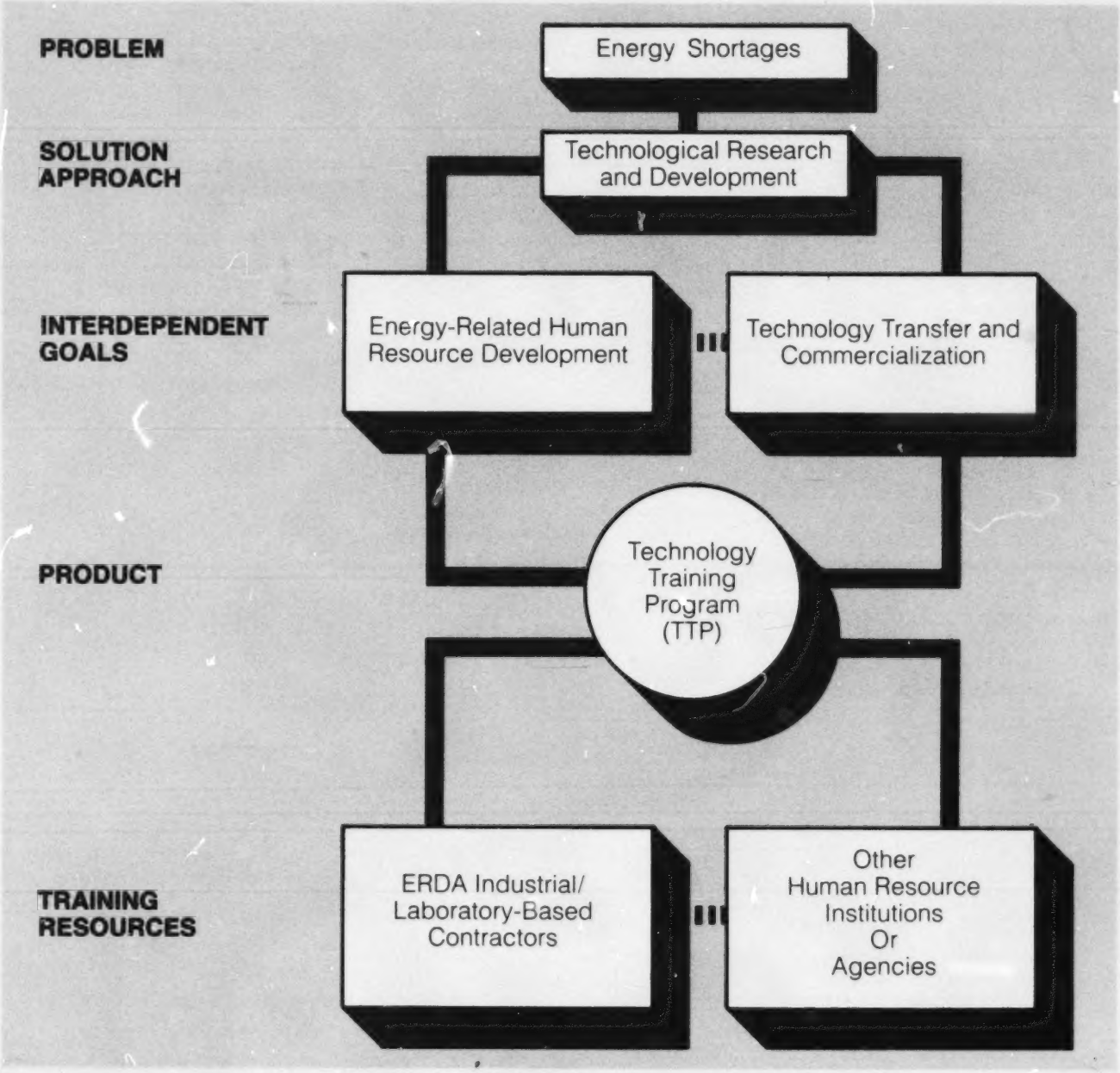
☐ INTERNAL AND EXTERNAL NEEDS

While a large portion of the energy research and development activities is conducted by ERDA contractors, achieving national energy goals will require the full participation of organizations in the private sector. ERDA, its contractors, and the private sector all draw on the same sources of trained manpower. ERDA cannot be narrowly concerned with meeting internal manpower requirements to the exclusion and detriment of external organizations. In fact, "training for the needs of others" is an important characteristic of TTP.

☐ SELECTED INVOLVEMENT

In most cases the labor market operates to provide the quantity and quality of manpower needed.

Figure 1: TTP in a Systems Framework



Intervention is required only when there is an existing or projected shortage of manpower in a particular occupation or when the quality of training is deficient.

☐ CAPITALIZE ON EXISTING RESOURCES

In cases where involvement in training is necessary, improvements can best be accomplished by the mobilization, supplementation, and coordination of existing resources. This has two advantages over the development of entirely new training programs: (1) it is more economical in that duplication of effort is avoided, and (2) improvements in training can be achieved much faster.

☐ AVOIDANCE OF COMPETITION

ERDA's involvement in training is not in competition with either education institutions or Federal agencies more directly concerned with education and training, such as the Department of Labor. In TTP, ERDA's unique resources are used to supplement the resources of other organizations.

☐ ATTENTION TO ALL JOB LEVELS

An adequate manpower base for achieving energy goals entails sufficient numbers of qualified people at all occupational levels. Previous efforts to improve training in energy fields have been primarily concerned with the supply and training of scientists and engineers. Recently, increased emphasis has been placed on training for technical support occupations. TTP is a program focused on improving the quality of training at the technician and paraprofessional level in energy or energy-related fields.

Technology Transfer

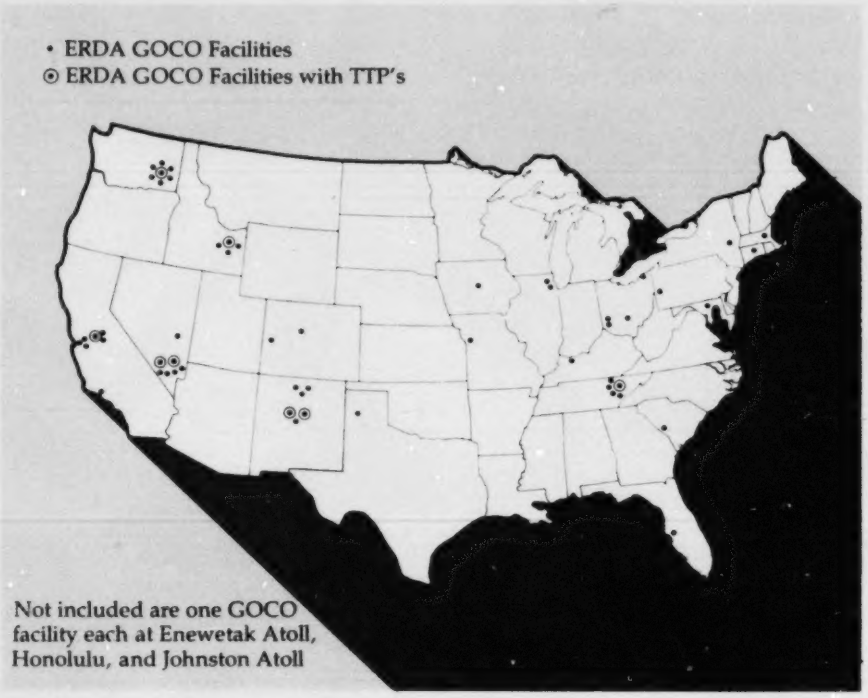
In addition to human resource development, technological development leads to a second goal—technology transfer. As shown in Figure 1, this goal is interdependent with the human resource development goal.

Technological development is not an end in itself. Technological advancements within research and development organizations must be transferred to the energy producers and consumers in the private sector before benefits can be realized. This diffusion process is often thought of as "first stage commercialization," and follows the research, development and demonstration (RD&D) stages.

In the course of developing new or improved sources of energy, many "spin-off" technological advancements are made within ERDA's research and development facilities. These advancements in science and engineering are the foundation upon which solutions to energy problems can be developed. It is important that these "spin-off" technologies, as well as those more directly related to energy production and consumption, be transferred to the private sector.

There is a variety of mechanisms for transferring technological advancements from a generating source to those people and organizations having a need for the new technologies. Three of the most common mechanisms are: (1) the diffusion of hardware (e.g., equipment, machines, etc.), (2) the sharing of information via technical and scientific publications, and other printed material, and (3) the transfer of knowledge and skills via training programs and the distribution of instructional materials. TTP, of course, is primarily based on the training mechanism, although effective utilization has been made of the other two channels as well.

Figure 2: ERDA Government-Owned Contractor-Operated Facilities


• ERDA GOCO Facilities
⊙ ERDA GOCO Facilities with TTP's
Not included are one GOCO facility each at Enewetak Atoll, Honolulu, and Johnston Atoll

ERDA GOCO System

A major portion of ERDA's energy programs is conducted within research, production and development facilities. Most of these institutions are Government-owned, contractor-operated facilities, called GOCO's. In a GOCO, the Federal Government owns the property and equipment, but a contractor staffs and manages the facility under the provisions of a prime contract.

There are 59 contractors in the ERDA GOCO system and they can be grouped in the following categories:

- 8 Multiprogram Laboratories
- 6 Major Engineering Development Laboratories
- 6 Specialized Physical Research Laboratories
- 15 Specialized Biomedical Research Laboratories
- 6 Nuclear Production, Development and Fabrication Facilities
- 18 Support Contractors

The map shows the location of these facilities and indicates which facilities have expanded and strengthened their training capability through participation in TTP.

Contractors undertake a wide variety of research, development and demonstration projects. Activities range from very basic scientific research to applied research necessary for the commercialization of new or improved energy technologies. Following are some of the major energy program areas in which GOCO's are actively involved:

- Coal Conversion
- Petroleum and Natural Gas
- In Situ Gasification
- Solar-Thermal Conversion
- Hot Brine Geothermal
- Laser Fusion Technology
- Magnetic Energy Storage
- Oil Shale Fracturing
- Conservation
- Environmental Impact

The GOCO system is a large and important national resource. Its importance can be measured in terms of human and physical assets. GOCO's have the capability of providing industrial-based technical training—training that, in many cases, cannot be duplicated in other institutions. The Technology Training Program is designed to mobilize that capability.

There are approximately 95,000 people employed in the 59 GOCO's, including 20,000 scientists and engineers and 35,000 technicians, operatives, and craftsmen. There is an unusually high concentration of individuals with doctorate degrees and persons with other advanced technical degrees. Because much of the energy research and development requires an interdisciplinary approach, the work force is comprised of experts from nearly every conceivable field. The training potential of GOCO's is greatly enhanced by the fact that these men and women are working at the very forefront of technological development. They are thus able to anticipate the technical skills required in jobs of the future, which is very important given the rapid technological change in energy fields.

The physical resources in the GOCO's are as impressive as the human resources. The plants and laboratories represent a cumulative capital investment of over $12 billion. The equipment and facilities reflect the latest advances that have been made in science and engineering. In many cases these physical resources are unique and do not exist outside the GOCO system. Seldom can these resources be duplicated in education institutions because of the newness of the technology or the extremely high capital costs.

Another reason why GOCO's are particularly well suited for providing training at the technician and paraprofessional level is that they have over 20 years' experience in conducting industrial-based skill training. Because of the special technical skills required in research and development activities, GOCO's have always been faced with the need to conduct training programs to meet internal manpower requirements.

The TTP concept is essentially a model of how various resources, especially the training capability of GOCO's, can be mobilized and coordinated to further the accomplishment of interdependent goals of human resource development and technology transfer.

Skill Enrichment

Quality technical training programs afford students the opportunity to develop the abilities and skills that will be required on the job. These abilities and skills can be broken down into two broad categories: (1) the mental capacity and conceptual understanding required for effective job performance, and (2) the ability to actually perform the job tasks, using the appropriate equipment, tools, or machines.

The traditional textbook and lecture approach is usually adequate for developing mental and conceptual skills. For example, an electronic technician trainee can acquire a knowledge of basic trigonometry by reading, listening to lectures, and working through a set of exercises. Special physical resources are not required to conduct such training.

However, developing actual job behavior skills is best accomplished by providing individuals the opportunity to practice those skills using the necessary materials and tools. For example, if the electronic technician is being trained to repair a quality control test unit with the diagnostic aid of a sophisticated oscilloscope, then the training will not be very effective without the oscilloscope.

Post-secondary 2-year education institutions are major suppliers of individuals with technician or paraprofessional skills. These institutions typically do an excellent job of developing mental and conceptual skills but sometimes are able to provide only limited opportunities for practicing task functions in a realistic work environment. The problems are particularly acute when rapid technological change occurs, rendering obsolete existing equipment and machinery in training institutions. Frequently, employing organizations hire graduates of traditional training programs and find that extensive on-the-job training is required before they are fully productive members of the work force.

These limitations have been long recognized by education and industry and numerous methods of improving the quality of technical training have been tested. One

of the most effective has proved to be a cooperative effort by education and industry, whereby each contributes to the training program those resources which the other lacks. The result is often a training program of higher quality than either could provide independently.

ERDA contractors have participated in many such cooperative ventures with education institutions, primarily with 4-year scientific and engineering colleges. TTP is different, in that it has involved several post-secondary 2-year institutions in collaborative efforts with GOCO's to improve technician and paraprofessional training.

One example of a long-standing program to train technician level workers is the Training and Technology (TAT) program operated by two GOCO's—Oak Ridge Associated Universities and Union Carbide-Nuclear Division. Since its inception in 1966, TAT has provided technical training for more than 3,000 students in a variety of areas, including welding, machining, and physical testing. TTP is a program that evolved largely out of ERDA's experience and success with TAT.

The Comprehensive Employment and Training Act (CETA) of 1973, administered through the U.S. Department of Labor, provides a comprehensive program of manpower services throughout the Nation. CETA was established to provide job training and employment opportunities for the economically disadvantaged, unemployed and underemployed on a decentralized basis using Federal revenue sharing. Control of local funding is given to local or state government "prime sponsors." Heavy reliance is placed on the establishment of effective, flexible programs planned and controlled at the local level. CETA resources, including funding, trainee recruitment, counciling, and post-training placement are an integral part of many TTP programs.

Technology Training Program

Objectives

The primary objective of the Technology Training Program is to provide quality technical training in energy or energy-related fields. The focus is on quality rather than quantity. In TTP, special emphasis has been placed on assuring that minorities and women have the opportunity to share in this technical training experience.

Specific objectives of TTP are:

☐ To increase the supply of technicians and paraprofessionals in energy or energy-related fields in areas where shortages exist. The labor market for workers at this skill level implies a local or regional focus.

☐ To supplement the training provided by education institutions with laboratory or industrial-based training experiences in which students have the opportunity to practice job tasks.

☐ To enhance technology transfer by providing technical training for non-ERDA organizations and by transferring to education institutions and industry the instructional materials used in TTP courses.

☐ To demonstrate, on a nationwide basis, the feasibility of utilizing the training capabilities within Government-owned, contractor-operated laboratories and production facilities to meet local and regional manpower requirements.

☐ To provide opportunities to develop unique skills needed in many technical occupations in a research and development environment.

Characteristics

It is difficult to provide a simple definition of TTP because it is a flexible program that can be shaped to work in a variety of situations. In lieu of a simple definition, it may be helpful to highlight several of the main characteristics of the established training programs.

☐ MOBILIZATION AND COORDINATION OF RESOURCES

Improvements in technical training are achieved when resources from government, industry and education are combined and when communication channels between various organizations are opened.

☐ TRAINING FOR INTERNAL AND EXTERNAL NEEDS

Training resources used in GOCO research and development contractors' facilities to meet internal manpower needs are used to meet the needs of organizations in the private sector.

☐ MULTIPLIER AND LEVERAGE EFFECT

The benefits of training are increased when program graduates transfer their newly acquired skills to others, and when instructional materials are transferred to education and private industry.

☐ DEVELOPMENT OF VARIOUS JOB SKILLS

Training programs develop both conceptual and job performance skills. Practicing job tasks in an industrial environment is emphasized.

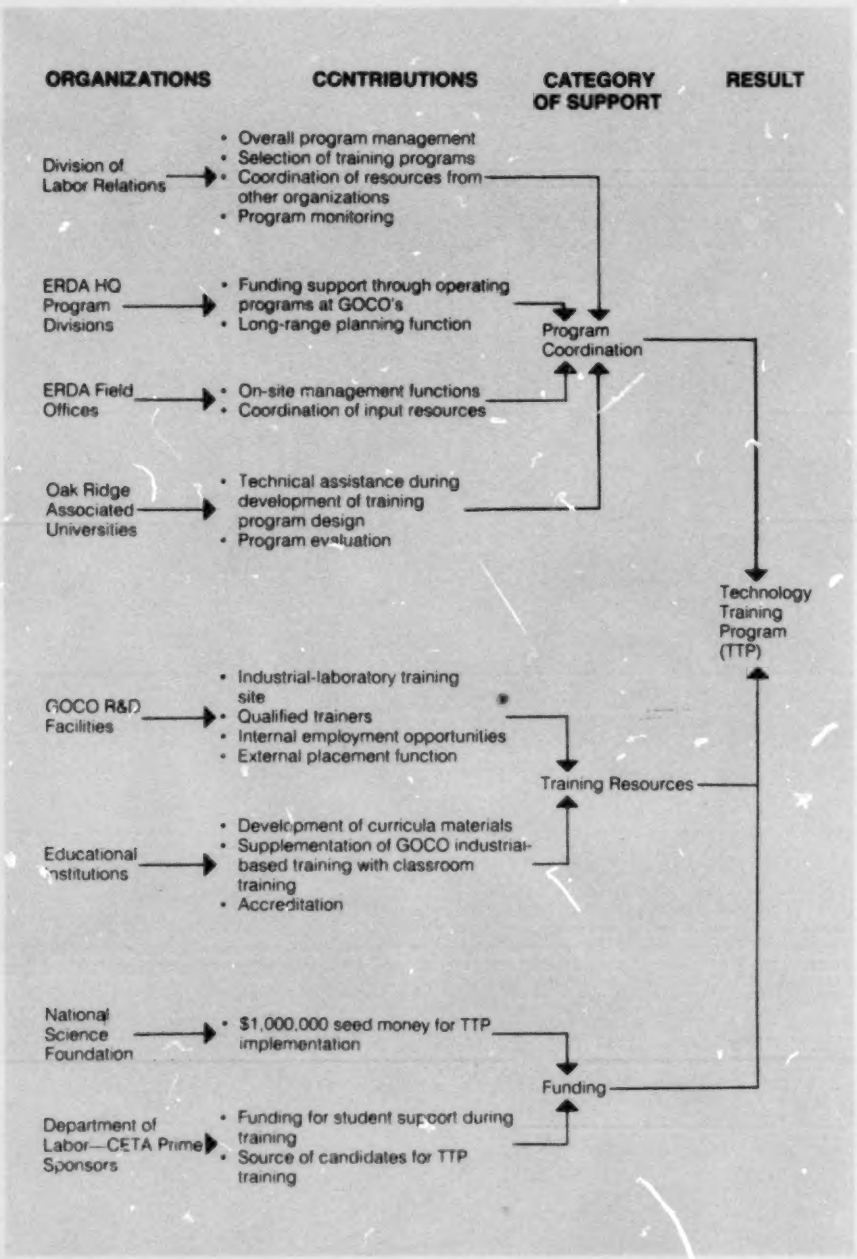
☐ PLACEMENT

Designed into each training program is an active placement activity which provides additional access to high technology careers for unemployed and underemployed minorities and women.

☐ EVALUATION COMPONENT

Built into each training program is an evaluation component to provide data for improving current operation and to better design future programs. Program operation is monitored and follow-up studies of graduates are conducted to determine the relative effectiveness of various training experiences.

Figure 3. Implementation of TTP


ORGANIZATIONS
CONTRIBUTIONS
CATEGORY OF SUPPORT
RESULT
Division of Labor Relations
• Overall program management
• Selection of training programs
• Coordination of resources from other organizations
• Program monitoring
ERDA HQ Program Divisions
• Funding support through operating programs at GOCO's
• Long-range planning function
Program Coordination
ERDA Field Offices
• On-site management functions
• Coordination of input resources
Oak Ridge Associated Universities
• Technical assistance during development of training program design
• Program evaluation
Technology Training Program (TTP)
GOCO R&D Facilities
• Industrial-laboratory training site
• Qualified trainers
• Internal employment opportunities
• External placement function
Training Resources
Educational Institutions
• Development of curricula materials
• Supplementation of GOCO industrial-based training with classroom training
• Accreditation
National Science Foundation
• $1,000,000 seed money for TTP implementation
Funding
Department of Labor—CETA Prime Sponsors
• Funding for student support during training
• Source of candidates for TTP training

Implementation

Implementation of the TTP concept was made possible by a $1 million grant from the National Science Foundation to ERDA in 1974. The Division of Labor Relations in ERDA Headquarters has responsibility for TTP implementation and overall program management.

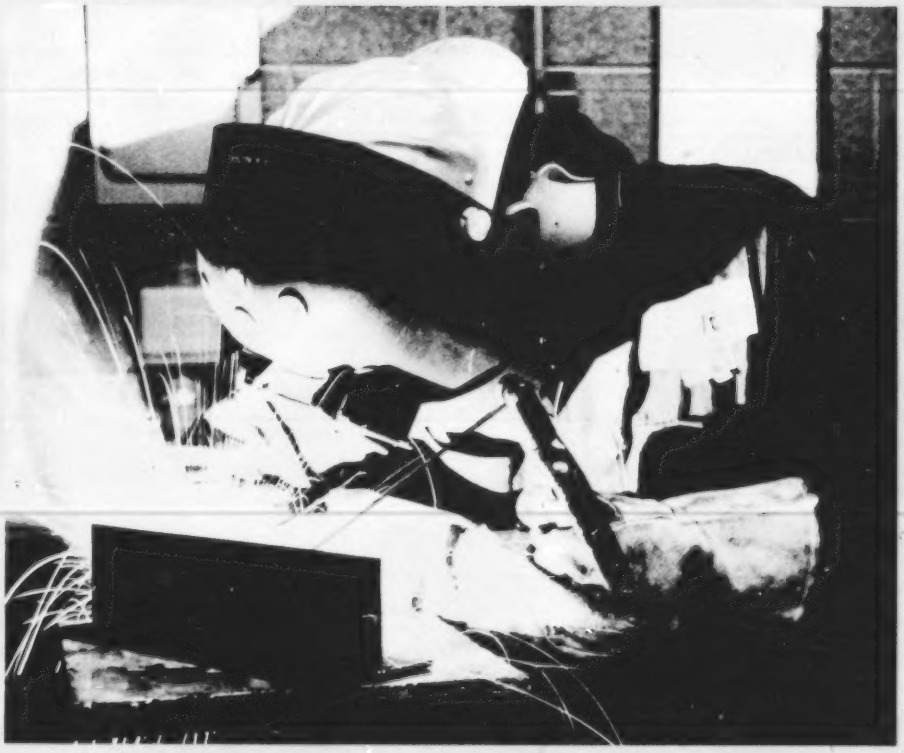
The key to the translation of the TTP concept into operating programs is the mobilization and coordination of resources from different organizations to achieve improved technical training. Participating organizations and their contributions are depicted in Figure 3.

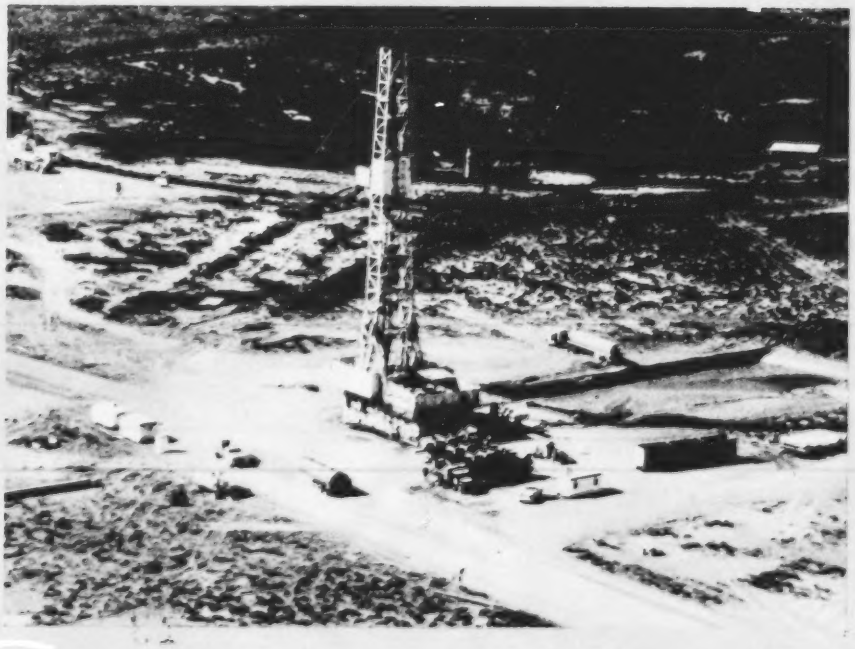
ERDA's request for GOCO training proposals under the TTP concept brought an enthusiastic response. Selection criteria included contractor training capability, community resources available, urgency of manpower need, the potential for technology transfer, top management commitment, and cost/benefit efficiency considerations.

TTP in Operation

There is a wide recognition at all levels of government that resources must be carefully coordinated if we are to succeed in expanding our energy-related technology base to meet the Nation's needs. The TTP stresses a partnership approach among government, education, and industry to coordinate existing resources and needs in the human resource development area.

A wide variety of technical skill is developed through TTP, including microprocessor technology, inhalation toxicology, welding inspection, electromechanical drafting, radiological safety and directional drilling. Following is a brief description which highlights the most significant characteristics of several programs which have been implemented utilizing the TTP concept.





Lawrence Livermore Laboratory

Participating Organizations

☐ GOCO—Lawrence Livermore Laboratory (LLL) is one of ERDA's multi-program laboratories. Located about 40 miles from San Francisco, California, LLL is operated by the University of California. LLL is one of the largest contractors, employing approximately 6,000 people, and undertakes research and development projects in a wide variety of areas, including weapons research, lasers, controlled thermonuclear research, air quality research, and cellular biology.

☐ EDUCATION—Two California community colleges in the San Francisco Bay area, Chabot College and Diablo Valley College, joined with LLL under a reciprocal agreement to transfer technology from the research laboratory to training institutions and other organizations.

☐ EMPLOYERS—Unlike Technology Training Programs (TTP's) at other GOCO's, trainees at LLL's program are individuals already employed as technicians. They are recruited from other ERDA contractor facilities, state, and municipal government agencies, private industries, and education institutions, and they return to their jobs after attending a 2-week technician upgrading course. The employing organizations play an active role in TTP by identifying individuals to attend the courses and by following through after training to see that the new technology is assimilated by the organization.

The Training Programs

Three short, intensified, technician-upgrading courses have been developed at LLL: Microprocessor Technology, Welding and Bonding Technology, and Digital Technology. The material is presented through a mixture of lecture, audio-visual, and participation techniques. Trainees are given tours of the facilities so they can see first-hand how the advanced technologies are actually used on the job. The TTP courses, though only 1 to 2 weeks in length, provide many opportunities for "hands-on" experience.

Multiplier and Leverage Effects

A major consideration in planning the courses was how to achieve the greatest amount of technology transfer through the modestly funded training program. The multiplier and leverage principles were used in three ways to maximize the impact of TTP.

☐ TRAINING TRAINERS—A large number of college instructors and trainers from industry have attended TTP courses. In fact, the interest among educators was so great that a special microcomputer course was offered for 22 college instructors. The impact of TTP is increased many fold as these individuals, in turn, train others in their organizations and education institutions.

☐ VIDEOTAPE COURSES—Special television equipment and a remote console make it possible to record lectures and demonstrations on tape. These tapes, which are available on a loan basis to education and industry, make it easy and inexpensive for educational and industrial employers to conduct subsequent courses at their own locations. The tapes and other curriculum materials are in much demand by colleges and industry.

☐ MICROCOMPUTER TRAINER—Scientists and engineers at LLL designed a microcomputer trainer to be used in the Microprocessor Technology course. The trainers are compact

1.

2.

1. The TTP classroom consists of two open-bay trailer modules joined to form a 60′ x 24′ room that can accommodate 32 trainees. Sophisticated visual aids afford a close-up view of diagrams and demonstrations.

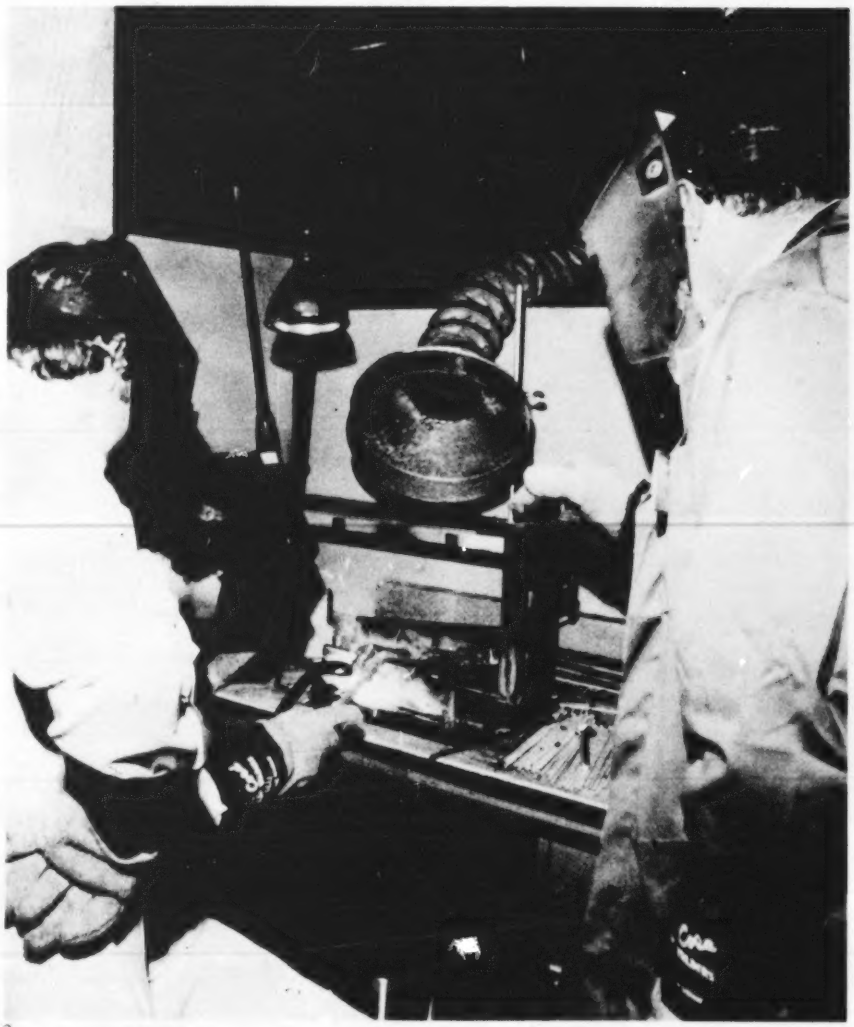
2. Trainees in the Microprocessor Technology courses get "hands-on" experience with the new LLL microcomputer-in-a-briefcase.

and fit into a standard attaché case. Following the design and prototype model developed by LLL, more than 200 units have been built and distributed by Diablo Valley College to industrial, education, and government organizations all over the country. Diablo Valley College is also establishing a "User's Group" to share information and exchange software programs.

Technology Transfer

More than 200 people have attended the technician upgrading TTP courses at LLL. They have come from 91 different organizations. The response was so enthusiastic that many qualified applicants could not be admitted to the program, due to space and funding limitations.

LLL's efforts to achieve technology transfer do not end at the graduation ceremony. In several instances, Laboratory staff has been instrumental in helping the technician apply the new skills and advanced technology on the job after training. These follow-up activities have resulted in successful transfer in a number of areas, including welding on a state water project, microcomputerized traffic controllers for a city government, a data collection system at a hydroelectric plant, an improved blood analysis system for hospitals, and improved clean welding techniques for the California Bay Area Rapid Transit System.



3.

3. Welding theories taught in the classroom are proven by trainees in the laboratory during "hands-on" experience. Building on the foundations of electric arc welding, trainees advance to master both MIG (metal inert gas) and TIG (tungsten inert gas) welding techniques.

Inhalation Toxicology Research Institute

The Government Contractor

The Inhalation Toxicology Research Institute (ITRI) is one of the specialized biomedical research GOCO laboratories. ITRI is operated by the Lovelace Biomedical and Environmental Research Institute and is located on Kirtland Air Force Base in Albuquerque, New Mexico. The Institute conducts a broad-based research program directed toward developing improved knowledge of health consequences of inhaled airborne materials, particularly those associated with energy conversion systems. Among the major facilities and equipment are laboratories, inhalation exposure areas, a veterinary hospital with facilities for detailed clinical observation of experimental animals, a canine metabolism building, and kennel buildings capable of housing more than 1,000 research animals.

Capitalizing on Unique Resources

The TTP at ITRI is a prime example of a GOCO facility effectively utilizing its unique resources to improve the quality of technician-level training. The highly specialized equipment and laboratories, the qualifications of the staff, and the advanced research projects undertaken at ITRI are the basis for an inhalation toxicology training program that is not available elsewhere in the country.

1.

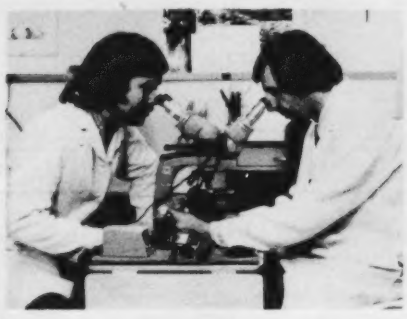
1. Biochemist and TTP trainee utilizing chromatographic methods for the analysis of lung lipids . . . an example of learning-by-doing.

The Training Program

The Technology Training Program at ITRI is designed to produce highly skilled technicians in the field of inhalation toxicology. The training program is 1 year in length and provides a blend of academic classroom work with practical on-the-job experience. Trainees spend approximately 25 percent of their time in formal classroom and laboratory instruction, and the remaining time on specific assignments, working with the professional and technical staff.

2.

2. Pathobiology trainee and experimental pathologist reviewing microscopic changes in tissues from diseased animals. The dual-headed microscope is an example of the sophisticated equipment specially designed for training.



3.

3. Aerosol physicist and trainee inspecting aerosal samples collected on different stages of a size-selector sampler.

Among the content areas covered in this TTP project are Health and Safety, Computer Applications, Basic Biomedical Concepts, Basic Pathobiology, Animal Care, Toxicology, Radioanalytical Procedures, Chemical Analysis, Aerosol Science, Radiobiology and Dosimetry. The course work complements the laboratory work assignments in that the formal curriculum is designed to impart an overall view of specific disciplines within the larger framework.

Quality Versus Quantity

The program has a clear focus on quality of training as opposed to quantity, reflecting the need for relatively few numbers of highly trained technicians in specialized research areas. A distinguishing feature of this TTP is the extensive on-the-job experience the trainees acquire during the yearlong program. Eighteen persons graduated from the first cycle and 12 are currently enrolled in the second cycle of the program. ITRI has been successful in advancing affirmative action goals through TTP; representation by women and minorities has been 60 percent.

Two-step Technology Transfer Process

Achieving technology transfer through human resource development is viewed as a two-step process at ITRI. The first step is to enhance the training capability of the GOCO by developing a structured training program, including curriculum materials, and a planned course of research activities for the trainees. With this step completed, TTP becomes an integral part of the organization's total manpower development plan.

The second step is to utilize this enhanced capability as a means for achieving technology transfer through training. Efforts are currently underway to collaborate with other organizations training or employing inhalation toxicologists. Opportunities for technology transfer in this area look particularly promising in light of growing environmental concerns related to energy production and consumption.

Oak Ridge Associated Universities/ Union Carbide Corporation-Nuclear Division

Participating Organizations

☐ GOCO'S—This Technology Training Program is conducted by two of ERDA's contractors—Oak Ridge Associated Universities (ORAU), and Union Carbide Corporation-Nuclear Division (UCC-ND)—both located in Oak Ridge, Tennessee. ORAU is a private nonprofit association of 45 universities in the south and conducts diverse programs of scientific research, education, information and training for private and public agencies. ORAU provides overall management of the TTP, some of the classroom instruction, and recruitment and placement services.

UCC-ND operates four major facilities for ERDA: a gaseous diffusion plant in Paducah, Kentucky, and three facilities in Oak Ridge—a second gaseous diffusion plant, Oak Ridge National Laboratory, and the Y-12 plant, a weapons fabrication facility. The TTP training site is at Y-12. In addition to providing the training site, UCC-ND draws upon its highly skilled technical staff for craftsmen to serve as TTP instructors.

☐ EDUCATION—Roane State Community College, Harriman, Tennessee, participated with ORAU and UCC-ND in developing the training program. Trainees receive college credits for math courses taught by Roane State in conjunction with TTP course work.

☐ CETA—Under the Comprehensive Employment and Training Act of 1973 (CETA), three local CETA organizations have sponsored trainees at TTP. They are the Mid-Cumberland Human Resource Agency, the Upper-Cumberland Human Resource Agency, and East Tennessee CETA.

The Training Program

A 9-month Welding Inspection Technician course has been established under TTP. The course is divided into two parts—3 months are spent on welding and 6 months on physical testing. "Hands-on" experience is emphasized in the program. Trainees work on class projects in the shop for approximately 75 percent of the training time; the remainder is spent in classrooms learning theory, interpretation of codes and standards, blueprint reading, math, and other background material.

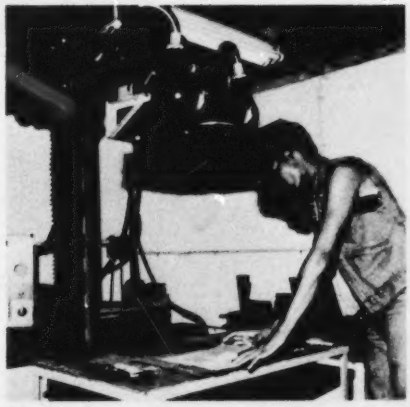
Trainees develop competence in welding a variety of materials using several welding techniques, including shielded metal arc welding, gas tungsten arc welding, and gas metal arc welding. Both nondestructive (ultrasonic, radiographic, eddy-current, liquid penetrant, and magnetic particle) and destructive (hardness, tensile, compression, and impact) procedures are covered in the physical testing portion of the course.

Capitalizing on Existing Resources

As with other TTP's, ORAU/UCC-ND's program is characterized by the effective use of existing training capabilities in GOCO's and education institutions. This TTP was able to capitalize on another training resource—the Training and Technology (TAT) program mentioned earlier in this brochure. Since TAT incorporates many of the principles of TTP, the Welding Inspection Technician course is subsumed under TAT. In fact, several components for the TTP course were taken from the TAT welding and physical testing courses already in place, so little additional development work was required prior to implementation.

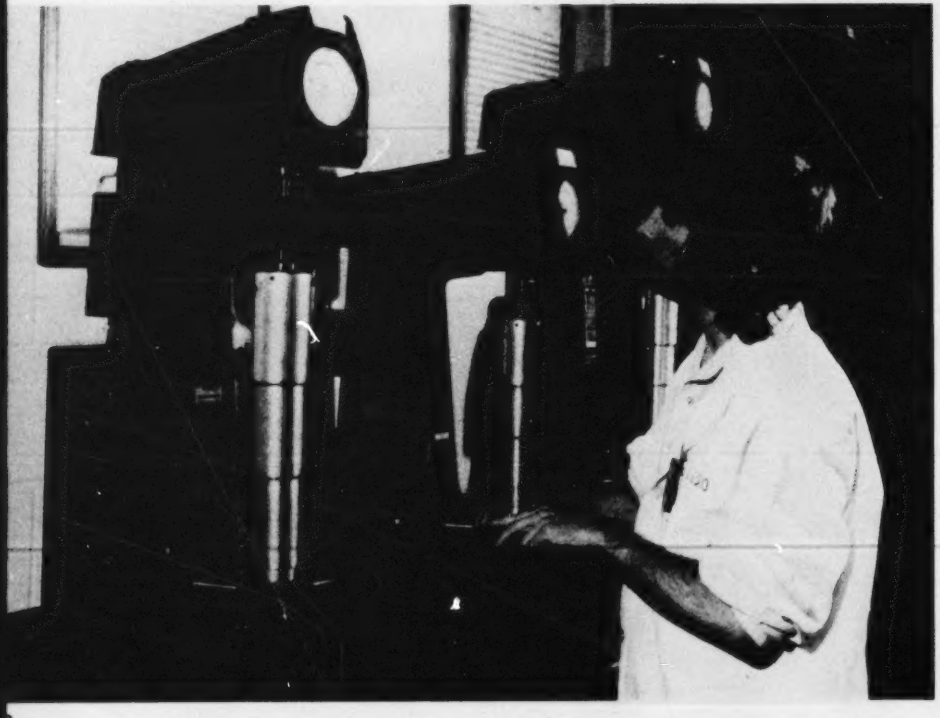
Human Resource Development

The first cycle of the Welding Inspection program has graduated 14 technicians, 8 of whom were women. This TTP takes a very broad view of human resource development and includes training components related to industrial behavior and the employment process, in addition to the technical skill-building components. For example, seminars are conducted



1. A series of welds are being prepared for x-raying. The x-ray pictures allow welding inspection technicians to assess the continuity of the weld and check for impurities in the weld.

1.



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2. Trainee using a hardness tester to measure the durable qualities of a weld. Participants in TTP receive skill training in physical testing, as well as welding.

3. Shielded metal arc welding technique is one of the TTP "hands-on" exercises. Industrial safety procedures and proper use of protective equipment are stressed throughout the course.

3.

on safety, attendance, resumé writing, and interviewing techniques.

Opening Communication Channels

The Technology Training Program in Oak Ridge is a good example of the long-lasting benefits gained when interorganization communication channels are opened. TTP provided the impetus for ORAU, UCC-ND and Roane State Community College to search for new ways to improve technical training through collaborative efforts. An agreement has been worked out whereby trainees in the TAT Drafter Technician program can earn up to 30 college credits from Roane State during the 9-month program. This amounts to approximately one-third the required credits toward an Associate Degree.

Sandia Laboratories

1. Drafting instructor and division supervisor check the drawing made by a TTP trainee.

1.

Participating Organizations

☐ GOCO—Sandia Laboratories is another of ERDA's multiprogram laboratories. The facility is operated by Sandia Corporation, a wholly-owned subsidiary of Western Electric, and is located on Kirtland Air Force Base in Albuquerque, New Mexico. Sandia's primary mission is nuclear weapons research and development with substantial involvement in nuclear safeguards and energy-related fields. The work force numbers more than 6,000 at the Albuquerque installation, and approximately 1,000 at its branch in Livermore, California.

☐ EDUCATION—The Albuquerque Technical-Vocational Institute (T-VI) joined with Sandia in developing and implementing the TTP and continues to offer a major portion of the classroom instruction for the program.

☐ CETA—The local CETA prime sponsor provides trainee support through stipends and funds for other training fees, such as book deposits and lab fees.

The Training Program

The Technology Training Program at Sandia is a 9-month, intensified course designed to develop disadvantaged and unemployed men and women into highly skilled electromechanical or construction draftsmen. The program is divided into three trimesters:

☐ FIRST—Participants attend T-VI full time for academic training in drafting skills and related areas. Courses taken are: Basic Electronic Drafting, Electricity and Electronics Theory, Logic Fundamentals, and Technical Math.

☐ SECOND—Participants receive classroom and on-the-job training at Sandia and continue course work at T-VI. Courses taken during this period are: Technical Math, Communications, Electromechanical Assemblies Lab and Theory, and True Position Dimensioning.

☐ THIRD—Participants work full time at Sandia, devoting most of the time to on-the-job training. Courses taken are: Mechanical Definition, Manufacturing Processes, and Mechanical Design. Sandia hires some of the TTP graduates and assists T-VI in placing the others. Graduates receive a diploma from T-VI with an attachment that describes the special nature of their industrial-based training experience.

Human Resource Development

The program is in its third year of operation. Fourteen technicians graduated the first year and 15 graduated the second year. Presently, there are 13 participants in the third trimester of training. The placement rate is greater than 90 percent. Of the 29 graduates thus far, 17 were minorities or women.

As in other TTP's, at Sandia the "learning by doing" principle is stressed. During the third trimester trainees are hired on a temporary employment status by

2. Aerial photograph of Sandia Laboratories. The picture indicates the immensity of some of the GOCO facilities and the resources that can be drawn upon for improved technical training.

3. Participants in the TTP drafting course get ample experience "on the boards," working alongside experienced draftsmen and engineers.

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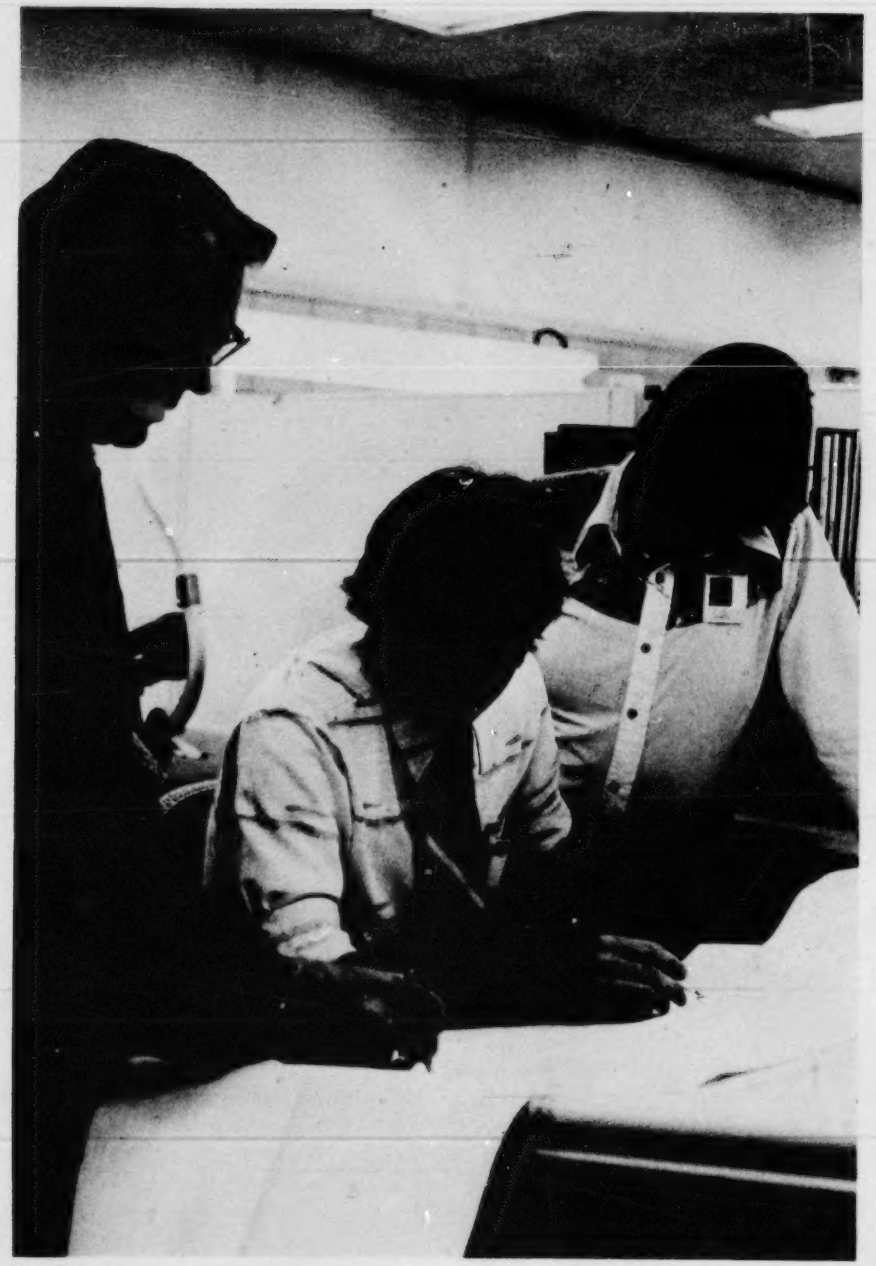


3.

Sandia. They refine their drafting skills by accomplishing assigned projects under the supervision of professional draftsmen. Thus, they are able to contribute to the productivity of the organization as they learn.

Technology Transfer

Sandia is a locus of electromechanical technological development, and engineers at Sandia have recognized the significant impact this development has on the skill requirements for electromechanical draftsmen. The training program has been designed to foster technology transfer in two ways. First, the close relationship between experts at Sandia and instructors at T-VI resulted in an upgrading of the courses to reflect the newest technology. Second, TTP graduates employed by other organizations have carried with them the advanced drafting skills.

Cooperation Not Competition

The Sandia T-VI TTP demonstrates the value of organizations collaborating to achieve a mutually desired goal—in this case, improved technical training for electromechanical draftsmen. The combination of organizational resources produces a program superior to what either organization could offer alone. Sandia and T-VI instructors work closely in coordinating and phasing the program elements and in monitoring trainee progress.

Reynolds Electrical & Engineering Company

Participating Organizations

☐ GOCO—Reynolds Electrical & Engineering Company (REECo) is a support contractor for ERDA at the Nevada Test Site (NTS), located approximately 65 miles northwest of Las Vegas, Nevada. The principal mission at NTS is underground nuclear testing. REECo provides support services such as radiation safety, industrial hygiene, mining, and tunneling operations.

☐ EDUCATION—The Clark County Community College (CCCC), Las Vegas, Nevada, assisted REECo in developing the program and provided some of the classroom instruction. Also, several of the training modules were borrowed from CCCC and taught by REECo instructors.

☐ CETA—The Las Vegas-Clark County Consortia played an active role in trainee selection during the implementation phase and provided supportive services throughout the training process.

The Training Program

REECo, in cooperation with the other participating organizations, has developed an intensified, 6-month Radiological Safety Technician training program. After completing the program, graduates are qualified for entry-level positions in nuclear power plants and at other sites where radioactive materials are used. Such positions entail the handling and storage of radioactive materials, the selection and care of anti-contamination clothing, the location of potential accidental sources of contamination, and other related functions.

The wide range of competencies needed by radiological safety technicians required the training program to include a correspondingly large number of subject areas. A sample of some of those areas indicates the diversity of the program: basics of physical and biological sciences, industrial hygiene, health physics, biological effects of ionizing radiation, mine rescue, and fire suppression. Courses in effective communications are taken at CCCC.

Capitalizing on Unique Resources

The NTS offers radiological facilities and training areas unmatched in the United States. On-site facilities include classrooms, shops, and laboratories specifically designed for radiological technician operations. They contain the latest training aids and work equipment which are continually upgraded to keep pace with advancing technology. REECo was able to take advantage of the fact that its staff had acquired considerable expertise in conducting radiological safety training programs. Such programs were required in the past to meet internal human resource development needs.

Human Resource Development

This TTP, as with several others, focuses on high quality training rather than numbers of individuals trained. Practical work experience is emphasized. During the last 3 months of the program, 3 days a week are spent with on-the-job training, and 2 days in the classroom continuing the formal instruction. The final exam consists of an intensive field exercise under realistic stress conditions in which the entire class responds to a simulated accident involving a spill of radioactive materials.

The first cycle of the program graduated 19 radiological safety technicians, 13 of which were women or minorities. The training is fully accredited and students can earn up to 30 credits from CCCC. The shortage of skilled radiological safety technicians resulted in graduates receiving good job offers from all over the country.

Briefly Mentioned

REECo is presently pilot testing two additional TTP courses. One is a 6-month work-study Industrial Hygiene Technician training program. Graduates will be qualified to perform the varied technician duties required by the Occupational Safety and Health Act of 1970. The second program consists of a 2-week course in Radiological Emergency Response Operations. Three pilot courses have been conducted for state government personnel to provide training in emergency response to

1. During simulated nuclear accident exercises TTP trainees practice using equipment designed for handling contaminated materials.

1.

2.

hypothetical accidents involving radiation at fixed nuclear facilities or during transport of radioactive material. In both programs, REECo recognized the unique contributions it could make toward alleviating critical manpower and training problems in other organizations.

2. Trainees are evaluated during the stress exercises on radiological safety technician procedures. Observers rate trainees as they care for an accident victim.

3. Trainees check simulated accident vehicle for radioactive contamination. The roll of tape held by the woman trainee is used for marking radioactive areas.

3.

Thompson Van Bebber Directional Drilling Services Company

Participating Organizations

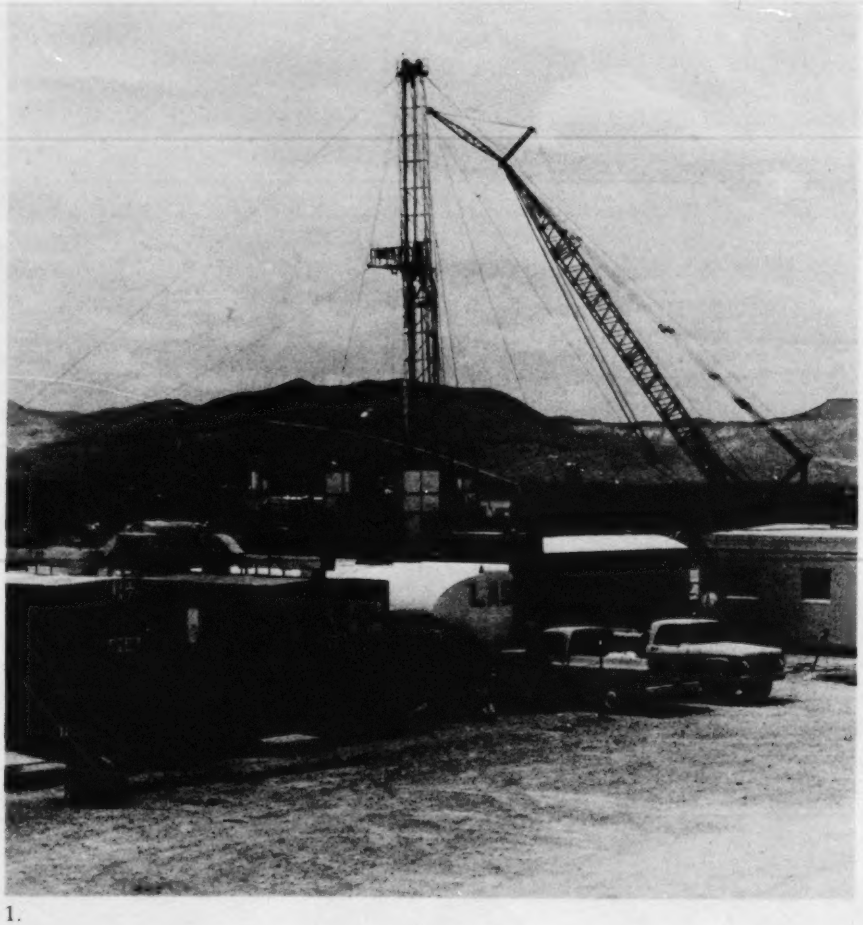
□ ERDA CONTRACTORS —The Thompson Van Bebber Directional Drilling Services Company (TVD) is a support contractor at the Nevada Test Site (NTS). TVD is a small organization comprised of engineers and technicians specialized in the science of directional drilling. The Reynolds Electrical & Engineering Company (REECo) assisted in developing and implementing the program and provides recruiting and placement services.

□ EDUCATION—Clark County Community College (CCCC) also helped design the program and taught trigonometry and drafting courses for TTP trainees.

□ CETA—The Las Vegas-Clark County Consortia played an important funding and trainee supportive services role in TVD's program as it did with the other TTP's established at NTS.

The Training Program

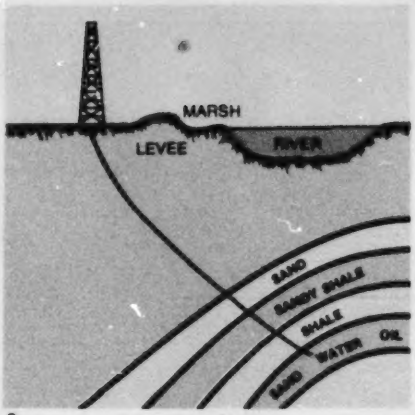
A 6-month intensive Directional Drilling Technician program was established at NTS, involving the usual TTP blend of classroom instruction and on-the-job training experience. TVD provided instructors and the site for OJT. Among the areas covered were Bore Hole Survey Instruments, Survey Calculations, Vector Sheet Calculations, Proposal Development, Drilling Assemblies and Stabilization, Fire Prevention, and other Safety Aspects.



1.

1. Drill site where trainees get "hands-on" experience on the rig to supplement classroom theory.

Graduates are prepared to assume entry-level positions in offshore drilling and other operations where holes must be bored into the earth diagonally rather than vertically. Since the angles and directions for such drilling are determined by complex mathematical calculations, developing mathematical skills is given heavy emphasis in the program.



2.

2. Target areas previously considered inaccessible for traditional drilling applications are the commonplace challenges which are met through directional drilling technology.

3.

3. Directional survey data, collected during an 8-hour shift on rig, is later used in classroom environment to develop drilling proposals.

Competency-Based Instruction

An important feature of TVD's TTP is that it is tailored to meet the individual needs of each trainee. This is quite different from lock-step programs where everyone is exposed to the same training experiences regardless of background and previous experience. Trainees' knowledge and skills are carefully assessed throughout the program. This competency-based approach is especially valuable when relatively expensive training is offered and when the participants begin the program with widely varying skill levels.

Training For The Needs of Others

Directional drilling is a highly specialized field. It is estimated that there are only 200-300 directional drillers in the world. Surveys conducted by TVD/REECo indicated a critical need for few numbers of highly trained individuals. Educational institutions do not offer programs in directional drilling. Private drilling companies are able to upgrade the technical skills of experienced drilling personnel for directional work. But, because of exorbitant costs associated with downtime of operational drilling rigs for training purposes, they do not train inexperienced individuals as entry-level directional drillers. The operation at NTS offers a unique opportunity to achieve technology transfer by training for the needs of others. The nine graduates of the first cycle of TTP have received job offers from all over the U.S., and even a few for work in other countries. Six of the nine graduates are women or minorities, which is particularly significant considering the fact that directional drillers are almost exclusively Anglo males.

Adequate Supply of Energy Manpower

The Directional Drilling Technician training program is a good example of ERDA contractors combining resources with other organizations to assure an adequate supply of technical manpower for energy-related occupational areas. The program is innovative. The advanced technology of directional drilling used at NTS in conjunction with the Nation's underground nuclear testing program is transformed through TTP. The result is a commodity that is of direct and critical relevance to drilling operations for oil, natural gas, and geothermal energy production.

Conclusion

It is beyond the scope of this brochure to present a detailed evaluation of the Technology Training Program. However, summarizing the results of the training programs described earlier, TTP appears to be a highly effective and efficient manpower development delivery system for training individuals at the technician and paraprofessional skill level.

The TTP concept grew out of the recognition that the Government-owned energy research and development facilities offer unique opportunities to enhance the quality of training provided technicians and paraprofessionals in energy fields. While ERDA's primary mission is energy research and development, this brochure has described how ERDA, by capitalizing on the human and physical resources inherent in its contractor system, can play an important supportive role in the area of human resource development. Particularly noteworthy is the mutually supportive relationship that has been achieved between ERDA and the Department of Labor through the Comprehensive Employment and Training Act sponsorship of individuals taking TTP courses at the Government-owned, contractor-operated facilities (GOCO's).

In addition to optimizing the use of existing resources, TTP involves the melding of resources from different organizations. One of the significant conclusions that can be drawn from ERDA's experience with TTP is that organizations are willing to participate in such collaborative efforts to the degree that outcomes are relevant to organizational goals. Even though the program rests on the existence of independent resources, its successful implementation is a function of overlapping organizational goals. In this sense TTP is a catalyst for opening communication channels to promote better interorganizational exchanges related to human resource development and technology transfer.

Current trends indicate that the Technology Training Program, or some variant of the TTP concept, will continue to be a viable approach in the future. First, the energy problem is becoming more critical, not less, and GOCO's will remain a vital resource in the search for solutions. The need to optimally utilize that resource in innovative ways will become even stronger in the future.

Second, increased emphasis is being placed on human resource development as part of the solution to the unemployment problem. TTP's focus on high quality training leading to long-term technical career opportunities makes the program an attractive means for assisting in the solution to this problem.

It is hoped that ERDA will be able to expand the TTP concept within its contractor system and that other organizations will seek similar opportunities to work cooperatively toward meeting the Nation's energy and human resource needs.

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